How Accurate Are Equatorial Pacific Upper Ocean Currents Computed With a Model and Data Assimilation?

D. Halpern (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109; ph 818-354-5327; email david.halpern@jpl.nasa.gov)
D. Behringer (National Oceanic and Atmospheric Administration National Centers for Environmental Prediction, Camp Springs, MD 20746; ph 301-763-8193; email david.behringer@noaa.gov)

At the equator, the vanishing Coriolis frequency eliminates the geostrophic balance. How then to describe monthly mean zonal currents at the equator? In situ upper ocean current observations are sufficiently accurate for the task. However, during 1996-1998 only 5 current measurement sites (147E, 165E, 170W, 140W, 110W) were maintained by the ENSO Observing System along the 17,000-km width of the equatorial Pacific Ocean. To describe currents elsewhere along the equator requires an ocean model and data assimilation system, i. e., numerical ocean analyses. Several tests were made to evaluate 1996-1998 monthly mean zonal currents computed at the National Centers for Environmental Prediction, in which surface and subsurface temperature measurements were assimilated into version 3 of the Geophysical Fluid Dynamics Laboratory modular ocean model. Computed and observed currents are compared. In April 1997 when a "big" Kelvin wave occurred, assimilation of temperature data provided a tremendous improvement in the vertical distribution of zonal current, i. e., u(z), at 140W and 110W. In addition, data assimilation improved the 36-month mean u(z) at 147E. However, addition of temperature data reduced the representativeness of the computed mean u(z) at 165E and 110W and had no impact at 170W and 140W; at each of these four sites the observed vertically integrated mean u(z) was greater than the computed current. With regard to temporal variability, data assimilation reduced the difference between the computed and observed depth-averaged standard deviations at 165E, 170W and 140W; at 147E and 110W, data assimilation created too much variability in the computed currents. The depth-averaged root-mean-square (rms) difference between observed and computed currents revealed an impact of data assimilation at only 110W, where data assimilation increased the rms difference. How to create computed currents more representative of observations is the subject of ongoing numerical experiments (e. g., salinity, sea surface topography, winds), which will be described.